



FAA-E-2652a  
October 24, 1978  
Superseding  
FAA-E-2652, 4/19/76

## DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION SPECIFICATION

TUBE 16-INCH, HIGH CONTRAST CATHODE RAY (BRITE)

### 1. SCOPE

1.1 Scope. - The component covered by this specification is a 16-inch diameter, round, high contrast, high resolution, cathode ray tube with 53 degrees magnetically driven deflection angle and electrostatic focusing. The faceplate shall be provided with a bonded implosion panel containing a color selective filter. The front face shall be etched and shall be coated with a special antireflective coating as specified herein. The tube is to be used in a bright radar indicator tower equipment (BRITE).

### 2. APPLICABLE STANDARDS

2.1 FAA standards. - The following FAA standard specified in the invitation for bids or request for proposals form a part of this specification and are applicable to the extent specified herein.

(Copies of this specification and of the applicable FAA documents may be obtained from the Federal Aviation Administration Contracting Officer issuing the invitation for bid or request for proposal. Requests should fully identify material desired, i.e., specification numbers, dates, amendment numbers; also, requests should state the contract involved or other use to be made of the requested material.)

2.1.1 FAA standard. - FAA-STD-013 Quality Control Program Requirements

2.2 Military specification and standards. - The following Military specifications and standards of the issue in effect on the date of invitation for bids or request for proposals form a part of this specification to the extent specified herein.

(Single copies of military specifications and standards may be obtained by mailing requests directly to Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.)

2.2.1 Military specifications.

MIL-E-1( ) Electron Tubes, General Specifications for  
MIL-E-75 Electron Tube, Preparation for Delivery of

2.2.2 Military standards.

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes  
MIL-STD-1311 Test Methods for Electron Tubes  
MIL-STD-781 Reliability Tests: Exponential Distribution

2.3 Industry specifications. - The following specifications of the issues in effect on the date of invitation for bids or request for proposals form a part of this specification to the extent specified herein.

Glass Tempering Association Specification:

GTA62-8-7 Safety Windows for Laminating to TV Tubes

(Individual copies of the above specification may be obtained by request from the Glass Tempering Association, 1325 Topeka Avenue, Topeka, Kansas, 66612.

3. REQUIREMENTS

3.1 Description. - The contractor shall produce, test, and deliver a round, 16-inch diameter, high contrast, cathode ray tube with magnetic deflection, electrostatic focus, and a deflection angle of 53 degrees. An implosion safety panel containing a color selective filter shall be bonded to the faceplate. The outer surface of the safety panel shall be etched and shall be treated with an antireflective coating. The deliverable cathode ray tube shall meet all requirements of this specification.

3.2 Materials. - Unless otherwise specified, materials shall be in accordance with MIL-E-1( ).

3.2.1 Bulb material. - Bulb material shall be in accordance with Corning bulb number J127C1 or equal, except that a nonconductive bulb material may be used in place of glass.

3.2.2 High voltage anode connector assembly. - A complete high voltage anode connector assembly, AMP P/N 1-83795-3, or equal, shall be provided as a part of each tube.

**3.2.3 Conductive coating.** - The CRT shall have a conductive coating on the outside around the bell, as shown in Figure 1. Resistance between any two points on the conductive coated surface shall be less than 5000 ohms. An anticorona coating shall be applied to the area shown in Figure 1. To ensure adequate adhesion of the conductive coat after drying, apply a strip of one-inch wide tape, 3M brand No. 250, or equivalent. When pressed down firmly by hand, and with removal of the tape, there shall be no layer removal. Minor spot or flake removal may be disregarded.

**3.2.4 Screen material.** - Screen material shall be a JEDEC P31 phosphor (aluminized).

**3.2.5 Safety panel.** - The safety panel shall be a laminated tempered glass (as specified in GTA62-8-7, Safety Windows for Laminating to TV Tubes, issued by the Glass Tempering Association).

**3.2.6 Color selective filter.** - The color selective filter shall be an integral part of the bonded safety panel. The color selective filter shall have a permanent transmission spectral peak of 525 nanometers, plus or minus 10 nanometers. The transmission amplitude at the spectral peak shall be 30 percent plus or minus 3 percent of the unattenuated value, and the permanent half amplitude bandwidth shall be a 60 nm maximum.

**3.2.7 Surface etch.** - The outer surface of the safety panel shall be etched. The threshold resolution observed through the panel shall fall within the range from 1:6 (corresponding to 3.5636 line pairs/mm) to 0:2 (corresponding to 1.1225 line pairs/mm) when using USAF resolving power test target type 1951 (see Figure 2), and USAF resolution chart data (see Figure 3). The method of measurement shall be in accordance with paragraph 4.6.1.

**3.2.8 Antireflective coating.** - An antireflection coating shall be applied to the etched front surface only of the implosion panel. This coating shall be a high efficiency antireflective coating, which will provide a reflectivity as specified in paragraph 3.2.8.1 over the wavelength range of 425 nanometers to 700 nanometers, as measured with GAMMA SCIENTIFIC Co. Model #191 spectrophotometer (or equal) using a smooth, flat, polished glass specimen (witness specimen).

**3.2.8.1 Surface reflectance.** - The reflectance from the outer surface of the safety panel, measured at an angle between 0 degrees and 15 degrees and at an angle of 30 degrees, shall not exceed the following limits:

<u>Wave Length Range</u>		<u>Percent Reflectance</u>
	<u>Angle = 0-15 degrees</u>	<u>Angle = 30 degrees</u>
440 nm	.75 absolute	
450 nm	.5 absolute	
470 nm	.3 absolute	
500-600 nm	.4 absolute	

	<u>Angle = 0-15 degrees</u>	<u>Angle = 30 degrees</u>
630 nm	.25 absolute	
680 nm	.5 absolute	
700 nm	.75 absolute	
450-650 nm		.8 absolute
425-700 nm		.5 average
500-620 nm		.5 average

3.2.8.2 Antireflective coating durability. - The coating shall be capable of withstanding each of the following conditions:

- (a) Continuous exposure for 24 hours in an atmosphere of 50 degrees C and 90 percent +2 percent relative humidity without evidence of deterioration.
- (b) A 20 rub erasure abrasion resistance test, following exposure to the temperature-humidity environment, without evidence of deterioration.
- (c) Continuous immersion for 24 hours in water containing 6 ounces of sodium chloride (common table salt) per gallon at room temperature without evidence of deterioration.
- (d) The "Scotch Tape" test without evidence of deterioration. Apply a strip of one-inch wide tape, 3M No. 250, or equivalent. When pressed down firmly by hand, and with removal of the tape, there shall be no evidence of deterioration.
- (e) Continuous operation over a temperature range from -10 degrees C to + 50 degrees C.
- (f) Continuous exposure to a salt spray atmosphere for 50 hours.

Acceptance tests and measurements shall be made using polished glass witness pieces that have been coated in the same batch as the safety panels being evaluated. Witnesses from each batch shall be tested in accordance with the requirements specified herein and the following documents:

MIL-C-675A Paragraphs 4.6.8, 4.6.9, and 4.6.11  
 MIL-M-13508B Paragraph 4.4.6  
 MIL-O-13830A Applicable requirements  
 MIL-STD-1241A Optical Forms and Definitions

### 3.2.9 RESERVED.

3.2.10 Blemishes. - Blemish criteria shall be as described in Method 5106 of MIL-STD-1311 and MIL-E-1H, Appendix D, except that the number and size of such blemishes shall not exceed those specified below. The examination shall be made without magnification. Elongated spots whose maximum widths are .010 inch or less shall be acceptable.

The maximum number and size of blemishes in the useful screen area (combined bulb face, resin, and safety panel) shall be as follows:

Total defects allowed	25
of which not more than 8 over .030 inch	
of which not more than 3 over .040 inch	
of which none over	.051 inch

Minimum separation between blemishes of 0.12 inch and larger shall be one inch. Ignore blemishes below .012 inch.

**3.2.11 Surface scratches.** - Scratches on the surface of the safety panel or CRT faceplate shall be no wider than .004 inches and no longer than one inch. The spacing between scratches shall not be closer than one inch, and the total number shall not exceed four.

**3.2.12 Edge Chips.** - The maximum allowable dimensions of edge chips are:

0.125-inch wide - 0.188-inch long - 0.040-inch deep outside of usable area around periphery of laminated panel only.

**3.2.13 Delaminations.** - There shall be no delaminations in the usable screen area of the CRT safety panel during the warranty period.

**3.2.14 Conductors.** - The size of conducting wires and other parts shall be ample to preclude overheating under maximum operating conditions of paragraph 3.4.1.

**3.3 Mechanical.** - The mechanical design of the cathode ray tube shall be as specified herein.

**3.3.1 Dimensions and pin connections.** - Dimensions and pin connections shall be as shown in Figure 1.

**3.3.2 Yoke reference line to electron gun.** - Minimum allowable distance between edge of getter cup, or other conductive gun parts, and yoke reference line shall be 2.75 inches.

**3.3.3 Neck and base straightness.** - The neck and base straightness shall be determined by inserting the neck of the tube in a cylinder five-inches long and 1.5-inch maximum inside diameter. The tube shall be considered acceptable for this parameter providing the cylinder can move freely between the reference line and the base of the assembled tube.

**3.3.4 Side terminal and base alignment.** - The anode connector (button) alignment with base pin position #3 shall be in accordance with Figure 1.

**3.3.5 High voltage connector assembly alignment.** - The spring steel clip shall be fastened to the CRT anode cap such that the lead is at right angles to the tube neck (see Figure 1). With the anode lead positioned as shown in Figure 1, the anode button shall be potted with G.E. Silicon rubber RTV112, or equivalent. The diameter of the molded cap shall be  $1\frac{5}{8}$ -inch  $\pm$   $\frac{1}{8}$ -inch with a nominal height of  $\frac{5}{8}$ -inch.

**3.3.6 Secureness of base, cap, and insert.** - Secureness of base shall be as specified in Method 1101B of MIL-STD-1311, except no immersion shall be required. At the contractor's option, the test may be performed on glass-base assemblies manufactured in the same manner as the base assembly on the CRT.

**3.3.7 Completed tube pressure.** - The completed tube pressure test shall be in accordance with Method 1141 of MIL-STD-1311.

**3.3.8 Marking.** - Marking shall be permanent and legible as described in Method 1105 of MIL-STD-1311. It shall include the manufacturer's name or symbol, type number, serial number on gun of CRT, lot number, date code, part number, warranty information, and a space for marking the date of installation.

**3.4 Qualification ratings.** - The cathode ray tube shall meet each of the electrical parameters described herein.

**3.4.1 Operational limits.** -

<u>Parameter</u>	<u>Absolute Maximum</u>	<u>Minimum</u>	<u>Operating Conditions</u>
Filament Voltage ( $E_f$ rms)	6.9V	5.7V	6.3V
Grid 1 Voltage ( $E_{c1}$ )	-180 Vdc	----	Adj.
Grid 2 Voltage ( $E_{c2}$ )	500 Vdc	----	300 Vdc
Accelerator Voltage ( $E_{b2}$ )	35,000 Vdc	----	27,000 Vdc
Focus Voltage ( $E_{b1}$ )	10,000 Vdc	----	Adj.
Focus Current ( $I_{b1}$ )	200 $\mu$ A	----	----
Peak Heater Cathode Voltage ( $E_{hk}$ )	+180 Vdc	----	----
Grid 1 Circuit Resistance	1.5 Megohms	----	----

**3.4.2 Voltage breakdown.** - Voltage breakdown shall be as described in Method 5201, Paragraph 4, of MIL-STD-1311 and shall meet these requirements with the absolute maximum voltage as specified in 3.4.1.

**3.4.3 Gas ratio.** - The gas ratio (GR) under conditions as described in Method 5206, Paragraph 2, of MIL-STD-1311 shall be a maximum of 0.25.

**3.4.4 Spot position.** - Spot position as described in Method 5231 of MIL-STD-1311 shall fall within a circle concentric with the CRT face and having a radius of 12 mm. An alternate method may be used of rotating the unshielded tube and taking four spot position readings 90 degrees apart. The average of the four readings is the actual spot position in the concentric circle as described herein.

**3.4.5 Grid cut-off voltage.** - Grid cut-off voltage shall be measured in accordance with Method 5241 of MIL-STD-1311. With the undeflected stationary spot correctly focused, the grid ( $E_{c1}$ ) to cathode cut-off voltage required to visually extinguish the spot in a room ambient of 10 footcandles, or less, as measured in the horizontal plan shall be between -60 and -90 Vdc with respect to the cathode.

**3.4.6 Electrode leakage.** - Electrode leakage shall be tested as described in Method 5251 of MIL-STD-1311. Values of leakage shall not exceed the following:

MIL-STD-1311 Reference		Tube Element	Test Limits
5251	#1	HK	5 uA
5251	#2	Grid 1	3 uA
5251	#3	Grid 2	5 uA
5251	#4	Focus	7 uA
5251	#5	Anode	10 uA

**3.4.7 Grid 2 current.** - Grid 2 current ( $I_{c2}$ ) as described in Method 5201 of MIL-STD-1311 shall not exceed 25 uA dc for  $E_{c1}=0$ .

**3.4.8 Inter-electrode capacitance.** -

Ck to all elements	-7pF maximum
$C_{g1}$ to all elements	-12pF maximum
$C_{g2}$ to all elements	-9pF maximum

**3.4.9 Internal arcing.** - In an ambient lighted area of less than 15 footcandles, with  $E_b = 27$  KVDC, and the grid 1 bias adjusted to provide a faint raster, the number of arcs shall be zero during three (3) minutes of operation. Flashing on the phosphor screen or arcing noise generated within the tube shall be construed as an indication of arcing.

**3.4.10 Focus anode current.** - Per Method 5201, Paragraph 1, of MIL-STD-1311, at  $I_b^2 = 50$  uA, focus anode current shall not exceed 20 uA.

**3.4.11 Cathode activity.** - Cathode activity shall be in accordance with MIL-STD-1311 Method 5236, except that the current measured shall be cathode current rather than anode current.

**3.4.12 Heater current.** - Heater current measured in accordance with Method 1301 of MIL-STD-1311 at 6.3 volts shall be a minimum of 540 mA and a maximum of 660 mA.

3.4.13 Stray emission. - Stray emission shall be as described in Method 5216, Paragraph 2, of MIL-STD-1311 under the conditions of:

$E_{b2} = 27,000 \text{ V}$      $E_{b1} = 7,500 \text{ Vdc}$      $I_{b2} = 0$      $E_f = 6.3 \text{ V}$   
 $E_{c2} = 300 \text{ Vdc}$      $E_{c1} = -200 \text{ Vdc}$      $E_{hk} = 180 \text{ Vdc}$

3.4.14 Anode current. - The anode current shall not exceed 550 uA with the phosphor at room temperature.

3.4.15 Brightness Uniformity. - With a full raster displayed at a brightness of 10 footlamberts, and an ambient light of less than 1 footcandle, no more than a 2 percent change in brightness shall be allowed between any two points on the viewing surface less than 1 inch apart. No more than a 10 percent change in brightness shall be allowed between two points anywhere on the viewing surface. This measurement shall be made using a spot-photometer with a 25 mil or less spot, or equivalent.

3.5 Overall performance. - The overall performance of the cathode ray tube shall meet the line width, contrast ratio, brightness uniformity, and transfer characteristics (dynamic range) requirements as specified herein. Unless otherwise specified, the scan rate shall be as defined in Table 1.

3.5.1 Line width. - With a grid drive of +50 volts above raster cutoff and with  $E_{b1}$  adjusted for best center focus, the line width (measured both vertically and horizontally) shall not exceed .012 inches in the center of the tube. In addition, line width shall be measured (both vertically and horizontally) at the edge of the usable area of the CRT and shall not exceed .016 inches when  $E_{b1}$  is adjusted for best edge focus. Anode current shall not exceed 550 uA, and it shall not be necessary to raise the focus voltage more than 400 volts to maintain focus over usable area of tube. Focusing voltage at the center shall be a minimum of 7000 Vdc positive and a maximum of 7,500 Vdc positive, and a focus current a maximum of 200 uA. The method of measurement shall be in accordance with paragraph 4.6.2.

3.5.2 Contrast ratio. - With a grid drive of +50 volts above raster cutoff, and with an incident illumination of 1,000 footcandles, the contrast ratio shall be a minimum of 17:1. The method of measurement shall be in accordance with paragraph 4.6.3.

3.5.3 Transfer characteristics. - With an incident illumination of 1,000 footcandles, the CRT shall provide minimum contrast ratios of 8:1, 4:1, and 2:1 with grid drives of 37.5 volts, 25 volts, and 18 volts above raster cutoff, respectively. The method of measurement shall be in accordance with paragraph 4.6.3.

3.6 Environmental requirements. - The tubes shall be capable of withstanding any of the following environmental conditions without mechanical damage or degradation of performance.



3.6.1 Barometric pressure. - The CRT shall be capable of operating normally at 30.0 inches of mercury (sea level) to 16.8 inches of mercury (15,000 feet) and shall not sustain any damage when stored or transported in an atmospheric pressure of from 16.8 inches of mercury to 5.54 inches of mercury (40,000 feet). Tests to demonstrate compliance with this paragraph are not required.

3.6.2 Relative humidity. - The CRT shall be capable of operating in a relative humidity from 0 to 95 percent including condensation due to temperature changes.

3.6.3 Salt atmosphere. - The CRT shall be capable of operating in a salt atmosphere as found in coastal regions and sea locations. Tests to demonstrate compliance with this paragraph are not required.

3.6.4 Ambient temperature. - The CRT shall be capable of operating in ambient temperatures of -10 degrees to +65 degrees C and shall withstand a storage temperature from -55 degrees C to +65 degrees C.

3.6.5 Vibration. - Vibration shall be a one-time test only and as described in MIL-STD-1311, Method 5111, at an amplitude of 0.020 inch.

3.7 Reliability. - The minimum acceptable mean time to failure (MTTF-0<sub>1</sub>), as described in MIL-STD-781B, shall be 5000 hours under the operating conditions specified in paragraph 3.4.1. Hours of service is defined as the time that the CRT has operating power or standby power applied. A failure is defined as noncompliance with any of the requirements given in paragraph 3.5, except that the contrast ratio requirements may decrease to 8:1 after 5000 hours of operation time. A contrast ratio of below 8:1 shall not be considered acceptable.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 General. - Unless otherwise specified in this specification or in the contract, all tests and inspections to determine compliance with the requirements of this specification shall be made by the contractor at his plant and shall be witnessed by a Government representative. The manufacturer shall comply with the quality control program requirements of FAA-STD-013.

4.2 Notification of readiness for inspection. - When the contractor has a CRT completed which meets the requirements of this specification, he shall notify the Contracting Officer that he is ready for Government inspection and tests.

4.3 Visual inspection. - Prior to submittal for Government inspection and test (4.4), each CRT shall be visually inspected to determine compliance with the requirements of this specification. This inspection includes checking for proper heater functioning and applicable mechanical inspection.

4.4 Inspection and testing. - Each tube shall be serialized or identified in accordance with paragraph 3.3.8. The following inspection and testing shall be performed after preheating per MIL-STD-1311, paragraph 4.8.6.1.

4.4.1 Design and qualification tests. - Sixteen CRTs randomly selected from the initial production lot shall be subjected to the tests listed in Table 2.

4.4.1.1 Reliability testing. - Twelve of the sixteen CRTs taken from the initial production lot shall be tested in accordance with Test Plan XX of MIL-STD-781B, Test Level A-1 to determine compliance with paragraph 3.7. Specific tests and failure analysis procedures shall be submitted to the Government for their approval 30 days prior to the test. The requirements of Section 5 of MIL-STD-781B shall apply. These tubes shall not be deliverable under the contract.

4.4.1.2 RESERVED.

4.4.1.3 Vibration testing. - Two of the sixteen CRTs randomly selected from the production run shall be tested in accordance with paragraph 3.6.5. These CRTs shall not be deliverable under the contract.

4.4.1.4 Pressure testing. - Two of the sixteen CRTs tubes shall be tested for resistance to implosion in accordance with paragraph 3.3.7.

4.4.2 Type testing (sampling test). - The total number of units selected for type testing shall be 5% of the total number on order. Each tube selected for type test shall be subjected to the tests shown in Table 3. Failure to meet with the acceptance criteria shall result in rejection of the lot. Selection of a unit for type testing within a given lot shall be made at random by the FAA representative.

4.4.3 Production test. - The tests listed in Table 1 shall be performed on each CRT procured, including those used in reliability and type testing as described in paragraphs 4.4.1.1 and 4.4.2.

4.5 Inspection of preparation for delivery. - Inspection of the preservation, packaging, packing, and marking for shipment and storage shall be in accordance with the requirements of the contract. Drop tests per MIL-P-116 and per method 1136 of MIL-STD-1311 shall be performed.

4.6 Method of measurement. - Measurements for surface etch, modulation, line width, and contrast ratio shall be made in accordance with the following subparagraphs:

4.6.1 Surface etch. - The method for measuring surface etch shall be as follows:

- (a) A U.S. Air Force resolving power test target type 1951 (three bar groups on an opaque background) is placed on a light box and observed through the etched implosion panel. A plexiglas spacer 1 1/2" high and 3 3/4" in diameter (Figure 2) is used to space the safety panel 1 1/2" from the resolution test target.

- (b) The brightness of the light box and viewing conditions are selected to maximize the unaided resolution of an observer with normal, or corrected-to-normal vision. The observer's vision and viewing conditions may be checked by placing a nonetched panel in the optical path. The observer should distinguish bars in at least group 3.6 corresponding to 14.25 line pairs/mm.
- (c) The acceptance criteria is as follows:

Using the test method as described above, the panel etch is acceptable when the threshold resolution observed through the panel is in the range from 1:6 (corresponding to 3.5636 line pairs/mm) to 0:2 (corresponding to 1.1225 line pairs/mm). See Figure 3 for USAF resolution chart.

**4.6.2 Line width measurement.** - Line width shall be determined by slowly reducing the vertical dimension of the 10" by 10" noninterlaced raster to the point where the line structure is no longer apparent. The vertical dimension of the compressed raster is then divided by 440 (the number of active raster lines) to yield the line width. Line width may also be measured using a single-line scan with a writing speed of .34 inches/microsecond at a refresh rate of 60 Hz.

**4.6.3 Contrast ratio measurement.** - With the raster height compressed as in paragraph 4.6.2, and with the focus voltage level set for best center focus (as in paragraph 4.6.2), the contrast ratio is determined by placing a 90% Reflectance Standard Card on the face of the CRT with the 90% surface facing outward. Light sources (Figure 4) are directed on the face of the 90% Reflectance Standard Card to obtain a reading of 900-foot lamberts on the Spectra Brightness Photometer. The lamp source shall be a tungsten filament type operating at 3200°K corrected to 5200°K + 400°K using a Colortran model #130-003 dichroic filter or equivalent. The 90% Reflectance Standard Card is then removed and the light reflected from the CRT face, plus the phosphor luminance, is read on the Spectra Brightness Photometer. The CRT assembly is then cut off and the light reflected from the CRT face is read on the Spectra Brightness Photometer. Contrast ratio for the CRT assembly shall be calculated by the equation:

$$CR = \frac{\text{Combined luminance (reflected from CRT face plus phosphor luminance)}}{\text{Reflected luminance from CRT face}}$$

**4.6.4 Contrast ratio range.** - In the measurement of contrast ratio range, the contrast ratio (CR) is defined as:

$$CR = \frac{B_{\text{data}} + B_{\text{background near data}}}{B_{\text{background near data}}}$$

when  $B_{\text{data}}$  is measured with ambient less than 1 ft-C and shall mean peak line brightness, and  $B_{\text{background near data}}$  shall be measured within 2mm of data center line.

Measurements shall be taken with all overlays and filters in place. Equivalent sunlight shall be defined as the light from a  $3200^{\circ}\text{K}$  tungsten halogen lamp with a filter (dichroic or other) to convert it to  $5200^{\circ}\text{K} \pm 400^{\circ}\text{K}$ , (Colortran model 130-003 Dichroic Filter, or equivalent).

Peak line brightness shall be measured using a narrow aperture scanned across a line and recorded on an X-Y plotter.

**5. PREPARATION FOR DELIVERY.** - Shall be per MIL-E-75.

**5.1 Preservation and packaging.** - Preservation and packaging shall be level A or C as specified in the contract. Each CRT shall be shipped with a removeable transparent paper sheet secured to the faceplate to protect the surface from finger-marks during installation of the tube. An instruction sheet shall be shipped with each tube to advise field personnel on proper materials and method of cleaning CRT face after installation and during the operational life of the tube.

**6. NOTES.** -

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TABLES 1 TO 3, SEE PAGES 13 TO 15

FIGURES 1 TO 4, SEE PAGES 16 TO 21

TABLE 1. QUALITY CONFORMANCE INSPECTION - ACCEPTANCE INSPECTION -  
PRODUCTION TESTS

TEST ITEMS	Ec1	*SCAN	Ec2	Eb1	Eb2	MIL STD	FAA	LIMITS		UNITS
	Vdc	RATE	Vdc	FOCUS	ANODE	1311	Spec.	Min.	Max.	
	Ef = 6.3V.ac/dc for all test items					METHOD	Para.			
Heater Current	-125	off	0	0	0	-	3.4.12	540	660	mA
Gas Ratio	adjust	off	300	-25	-25	5206.2	3.4.3	-	0.25	-
Surface Scratches							3.2.11			
Screen Blemishes	adjust	on	300	7500	12KV.	-	3.2.10	-	-	-
Spot Position	adjust	off	300	Best focus	27KV.	5231.1	3.4.4	-	12	mm
Spot Cutoff	adjust	off	300	Best focus	27KV.	5241	3.4.5	-50	-90	V.dc
Raster Cutoff	adjust	on	300	Best focus	27KV.	-	-	REF. ONLY		V.dc
LEAKAGE										
Grid #1										
Grid #2	AT							-	3	uAdc
Focus	SPOT	on	300	7500	27KV.	5251.1	3.4.6	-	5	uAdc
Anode	CUTOFF					through		-	7	uAdc
H-K + 180V						5251.5		-	10	uAdc
		on						-	5	uAdc
Grid #2 Current	Zero	unblanked	300	7500	27KV.	5201	3.4.7	-	25	uAdc
Stray Emission	-200	on	300	7500	27KV.	5216.2	3.4.13	None visible		
(HEATER AT +180V. RELATIVE TO CATHODE)										
		on								
Voltage Breakdown	-150	unblanked	500	9500	35KV.	5201.4	3.4.2	No breakdown		
Internal Arcing	adjust		300	7500	27KV.	-	3.4.9	None Visible		
FOCUS										
Center of Face	+50V above raster cut-off	on	300	adjust	27KV.	-	3.5.1	7000	7500	V.dc
7 1/4" below Center								-	200	uAdc
								-	400	V.dc
LINEWIDTH										
Center	+50 above raster	on blanked		Best focus	27 KV.	-	3.5.1	-	.012	inches
6.5" to right	raster	shrunk						-	.016	inches
6.5" to left	cutoff							-	.016	inches
Anode current								-	550	uAdc
CONTRAST RATIO										
	+50V above raster cutoff	on blanked shrunk		Best center focus	27KV	-	3.5.2	17:1	-	-

\* NOTE: The SCAN shall be either (a) a blanked, noninterlaced raster with a writing speed of .34 inches/microsecond and a refresh rate 60 Hz; raster size shall be equivalent to 10 inches by 10 inches, 440 active lines (minimum), 90% active field time, 83% active line time, or (b) a single line SCAN with a writing speed of .34 inches/microsecond at a refresh rate of 60 Hz.

TABLE 2. QUALITY CONFORMANCE INSPECTION - ACCEPTANCE INSPECTION - DESIGN QUALIFICATION TESTS  
(Includes all production tests and the following)

REQUIREMENTS OR TEST	*	NOTES	MIL STD METHOD	Spec. Para.	LIMITS		Units
					Min.	Max.	
Pressure			1141	4.4.1.4		45	psia
Vibration			5111	4.4.1.3	.020	-	inches
Reliability		MIL-STD-781B, Test Level A-1 and Section 5			3.7 5000	-	hours
					4.4.1.1		
Drop Test		MIL-P-116 and 1136				4.5 -	-

## TRANSFER CHARACTERISTICS

Grid Drive	Contrast Ratio
+50 V Above raster cutoff	17:1 Minimum
+37.5V Above raster cutoff	8:1 Minimum
+25V Above raster cutoff	4:1 Minimum
+18V Above raster cutoff	2:1 Minimum

CONTRAST RATIO RANGE	LINE	BRIGHTNESS
10 Ft-C Ambient		1 fL Max
1 Ft-C Ambient		1 fL Max
1000 Ft-C Ambient		-
2000 Ft-C Ambient		-
6000 Ft-C Ambient		-

CONTRAST RATIO RANGE	CONTRAST RATIO
5:1 Maximum	
15:1 Maximum	
17:1 Minimum	
8.5:1 Minimum	
2:1 Minimum	

4.6.4

**\*\* NOTE:** The transfer characteristics test and the contrast ratio range test should be performed on five tubes chosen at random from the 16 tubes selected per paragraph 4.4.1.

TABLE 3. QUALITY CONFORMANCE INSPECTION - ACCEPTANCE INSPECTION - TYPE TESTS

Requirements or Test	MIL STD 1311 Notes Method	FAA Spec Para.	LIMITS		Units
			Min	Max.	
<u>Sampling</u>		4.4.2			
<u>Test Conditions</u>					
<u>Interelectrode Capacitance</u>					
Cathode (CK) to all		3.6.2	-10°	+65°	C
Grid #1 (Cg1) to all		3.6.4	at 10° intervals		
Grid #2 (Cg2) to all		3.4.8			
<u>Color Selective Filter</u>					
Transmission Peak Wavelength		3.2.6			
Half-Amplitude Bandwidth					
Transmission Peak Amplitude					
<u>Surface Etch</u>					
Antireflective Coating					
Surface Reflectance	(USAF 1951)	3.2.7	515	535	nm
Antireflective Coating Durability		3.2.8	-	60	nm
		3.2.8.1	45	55	percent
		3.2.8.2			
<u>Line Width</u>					
7 1/8" to right of center		3.5.1			
7 1/8" to left of center		4.6.2			
<u>Transfer Characteristics</u>					
<u>Grid Drive</u>					
+50 V Above raster cutoff		3.5.3			
+37.5 V Above raster cutoff		4.6.3			
+25 V Above raster cutoff					
+18 V Above raster cutoff					
Contrast Ratio					
17:1 Minimum					
8:1 Minimum					
4:1 Minimum					
2:1 Minimum					
<u>Mechanical</u>					
<u>Face O.D.</u>					
Overall Length		3.3.1	15.75	16.00	inches
Stroke Reference Line to Center Face			25.25	26.00	inches
Stroke Reference Line to Electron Gun			14.85	15.63	inches
		3.3.2	2.75	-	inches
<u>Conductive Coating</u>					
Center Face to Start of Coating		3.2.3	3.50	5.50	inches
Stroke Reference Line to End of Coating			3.50	4.25	inches
<u>A Surrounding Anode (Without Conductive Coating)</u>					
(With Anti-Corona Coating)		3.2.3	5.00	-	inches
<u>A de Lead Length</u>					
3.3.5			15.50	16.50	inches
<u>Sealureness of Base, cap, and insert</u>					
1101B		3.3.6	-	-	-
<u>Finance of Marking</u>					
1105		3.3.8	-	-	-

ES: Vendor certified test data showing compliance to the specification will be acceptable in lieu of contractor testing. However, the Government reserves the right to witness vendor tests.

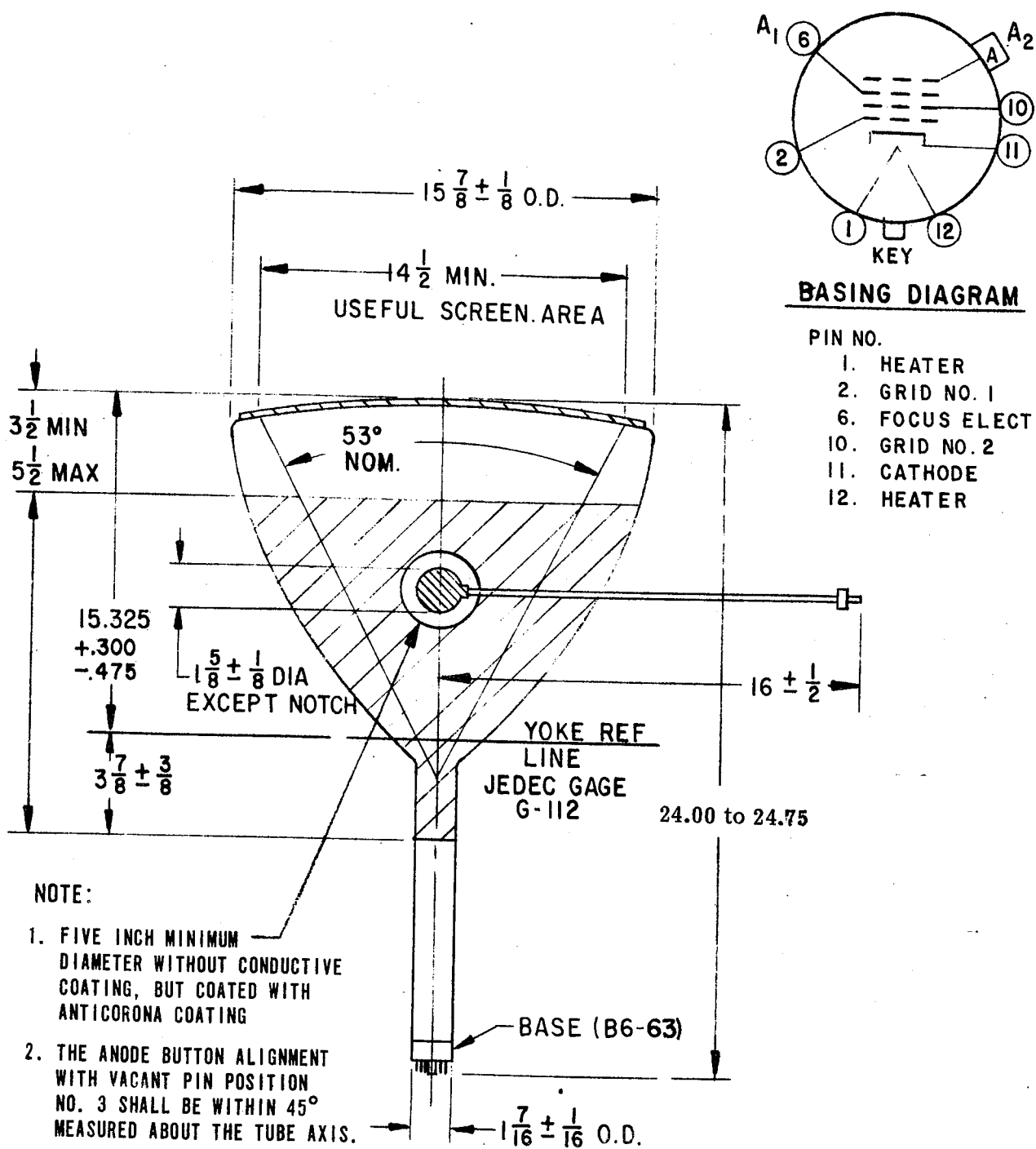
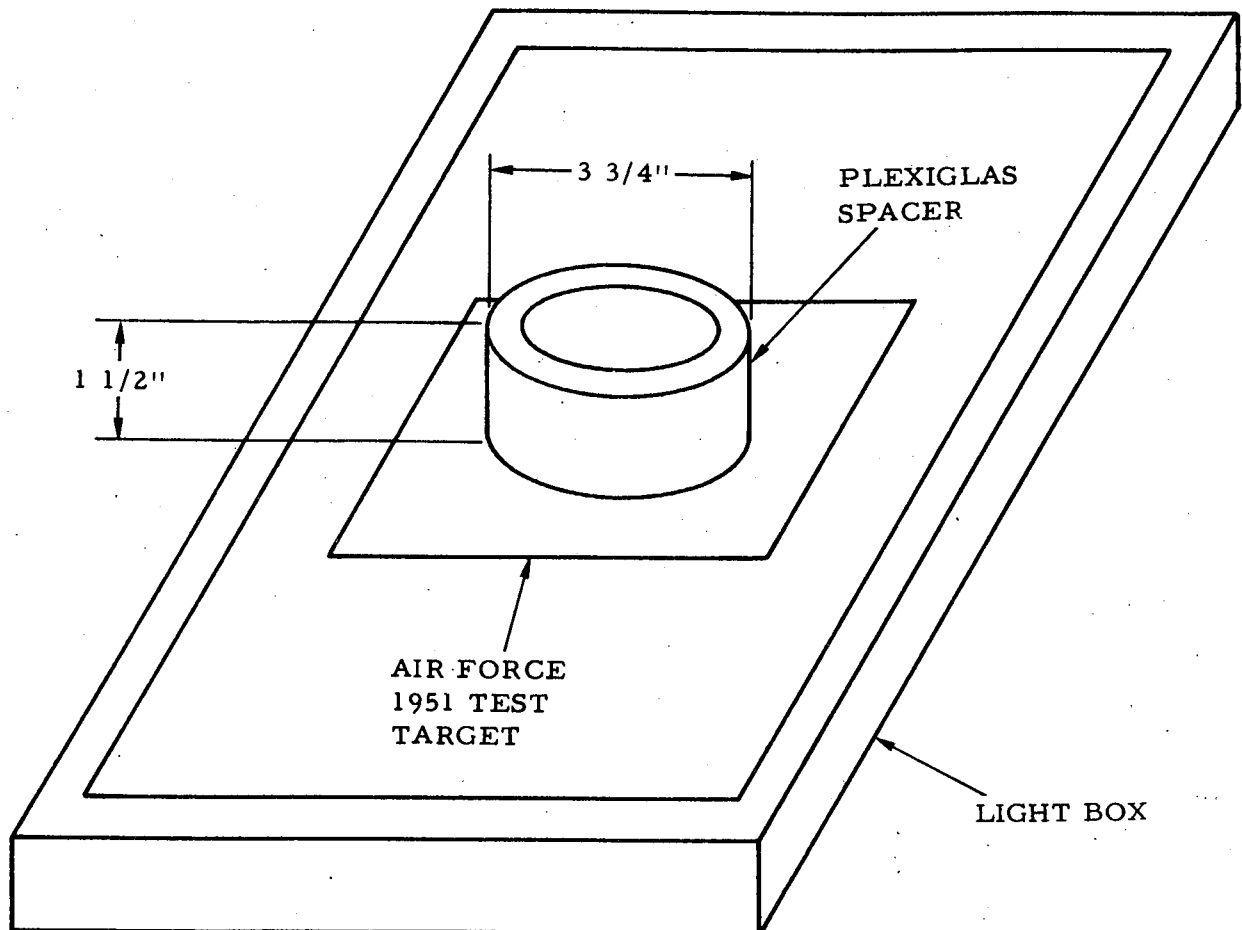


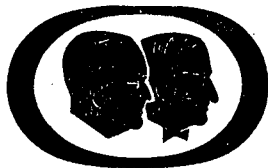
FIGURE 1: Dimensions and Base Diagram





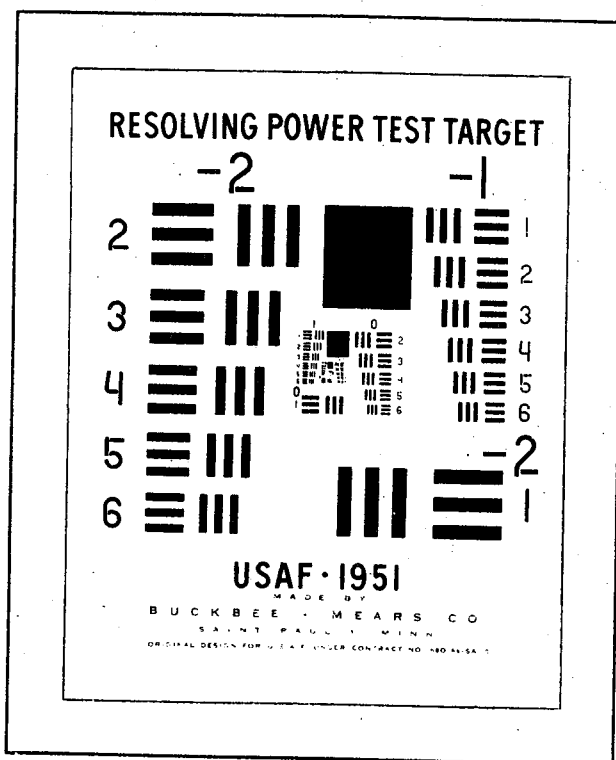
RESOLUTION TEST JIG FOR CHECKING CRT IMPLOSION PANEL ETCHING

Figure 2



## USAF RESOLUTION CHART DATA

### NOMENCLATURE AND SPECIFICATIONS



The proportionality of the line and element dimensions is given by the ratio of the unit widths of two subsequent elements. This ratio shall be the sixth root of two. At the head of every group shall be a group number indicating the number of li/mm of the largest pattern within the group in terms of powers of two. For example, a group number K-3 shall indicate eight li/mm for the largest pattern of this group. The group numbers shall be whole numbers, for example—1, 0, 1 etc. Within a group, every element shall be designated by an element number  $n=1$  (number 1 belonging to the largest element) through number 6 (number 6 belonging to the smallest element). The resolving power  $R$  represented by the element  $n$  of group  $K$  of the target can then be calculated from the equation.

$$R = \frac{K \text{ plus } n-1}{6}$$

Thus element 1 of group —2 has 0.25 li/mm, element 1 of group —1 has 0.5 li/mm, and element 1 of group 0 has 1 li/mm.

The range of the target shall include ten target groups from 0.25 to 227.5 li/mm or from group —2 to group 7.

Interval—a line or a space.

Unit—a line and the adjacent space.

Pattern—three lines and two included spaces.

Element—an arrangement of two patterns set at right angles to each other and separated by one unit width.

GROUP —2			GROUP —1		
(1)	.25 li. m/m	Interval = .07874 Unit = .15748 Element .94488 × .3937	(1)	.50 li. m/m	Interval = .03937 Unit = .07874 Element .47244 × .19685
(2)	.280625 li. m/m	Interval = .07014699 Unit = .14029398 Element .84176388 × .35073495	(2)	.56125 li. m/m	Interval = .03507349665 Unit = .0701469933 Element .4208819598 × .17536748325
(3)	.317475 li. m/m	Interval = .06200488225 Unit = .1240097645 Element .744058587 × .31002441125	(3)	.63495 li. m/m	Interval = .0310024411 Unit = .0620048822 Element .3720292932 × .1550122055
(4)	.356175 li. m/m	Interval = .0552677756 Unit = .1105355513 Element .6632133078 × .27633887825	(4)	.71235 li. m/m	Interval = .0276338878 Unit = .0552677756 Element .3316066536 × .138169439
(5)	.3994 li. m/m	Interval = .0492864296 Unit = .0985728592 Element .5914371552 × .246432148	(5)	.7988 li. m/m	Interval = .0246432148 Unit = .0492864296 Element .2957185776 × .123216074
(6)	.44545 li. m/m	Interval = .04419126725 Unit = .0883825345 Element .5302952124 × .2209563385	(6)	.8909 li. m/m	Interval = .0220956336 Unit = .0441912672 Element .2651476032 × .110478168

Figure 3 (1 of 3)

GROUP + 0		GROUP + 1	
(1)	1 li. m/m ————	(1)	2 li. m/m ————
	Interval = .019685 Unit = .03937 Element .23622 × .098425		Interval = .0098425 Unit = .019685 Element .11811 × .0492125
(2)	1.1226 li. m/m ————	(2)	2.245 li. m/m ————
	Interval = .01753674832 Unit = .03507349665 Element .2104409799 × .087683741625		Interval = .00876837416 Unit = .01753674832 Element .10522048992 × .0438418708
(3)	1.2599 li. m/m ————	(3)	2.5398 li. m/m ————
	Interval = .01550122056 Unit = .03100244113 Element .18601464678 × .077506102825		Interval = .00775061028 Unit = .01550122056 Element .0900732336 × .0387530514
(4)	1.4142 li. m/m ————	(4)	2.8494 li. m/m ————
	Interval = .01381694391 Unit = .02763388783 Element .16580332698 × .069084719575		Interval = .00690847195 Unit = .01381694391 Element .08290166346 × .034542359775
(5)	1.5874 li. m/m ————	(5)	3.1952 li. m/m ————
	Interval = .01232160741 Unit = .02464321482 Element .14785928892 × .06160803705		Interval = .0061608037 Unit = .01232160741 Element .07392964446 × .030804018525
(6)	1.7818 li. m/m ————	(6)	3.5636 li. m/m ————
	Interval = .01104781681 Unit = .02209563362 Element .13257380172 × .05523908405		Interval = .0055239084 Unit = .01104781681 Element .06628690086 × .027619542025
GROUP + 2		GROUP + 3	
(1)	4 li. m/m ————	(1)	8 li. m/m ————
	Interval = .00492125 Unit = .0098425 Element .059055 × .02460625		Interval = .002460625 Unit = .00492125 Element .0295275 × .012303125
(2)	4.49 li. m/m ————	(2)	8.98 li. m/m ————
	Interval = .00438418708 Unit = .00876837416 Element .05261024496 × .0219209354		Interval = .00219209354 Unit = .00438418708 Element .02630512248 × .0109604677
(3)	5.0796 li. m/m ————	(3)	10.1592 li. m/m ————
	Interval = .00387530514 Unit = .00775061028 Element .04650366168 × .0193765257		Interval = .00193765257 Unit = .00387530514 Element .023251830852 × .009688262855
(4)	5.6988 li. m/m ————	(4)	11.3976 li. m/m ————
	Interval = .003454235975 Unit = .00690847195 Element .0414508257 × .017271177375		Interval = .001727117989 Unit = .003454235979 Element .020725415874 × .0086355899475
(5)	6.3904 li. m/m ————	(5)	12.7808 li. m/m ————
	Interval = .00308040185 Unit = .0061608037 Element .0369648222 × .01540200925		Interval = .001540200926 Unit = .003080401852 Element .018482411112 × .00770100463
(6)	7.1272 li. m/m ————	(6)	14.2544 li. m/m ————
	Interval = .0027619542 Unit = .0055239084 Element .0331434504 × .013809771		Interval = .001380977101 Unit = .002761954202 Element .016571725218 × .0069048855075

Figure 3 (2 of 3)

GROUP +4		GROUP +5	
(1)	16 li. m/m	(1)	32 li. m/m
Interval = .0012303125 Unit = .002460625 Element .01476375 × .0061515625		Interval = .00061515625 Unit = .0012303125 Element .007381875 × .00307578125	
(2)	17.96 li. m/m	(2)	35.92 li. m/m
Interval = .00109604677 Unit = .002192093541 Element .013152561246 × .0054802338525		Interval = .000548023385 Unit = .00109604677 Element .00657628062 × .002740116925	
(3)	20.3184 li. m/m	(3)	40.6368 li. m/m
Interval = .000968826285 Unit = .001937652571 Element .011625915426 × .0048441314275		Interval = .0004844131425 Unit = .000968826285 Element .00581295771 × .0024220657125	
(4)	22.7952 li. m/m	(4)	45.5904 li. m/m
Interval = .000863558994 Unit = .001727117989 Element .010362707934 × .0043177949725		Interval = .000431779497 Unit = .000863558994 Element .0051813053964 × .0021588772485	
(5)	25.5616 li. m/m	(5)	51.1232 li. m/m
Interval = .000770100463 Unit = .001540200926 Element .009241205556 × .003850502315		Interval = .0003850502315 Unit = .000770100463 Element .004620602778 × .0019252511575	
(6)	28.5088 li. m/m	(6)	57.0176 li. m/m
Interval = .000690488550 Unit = .001380977101 Element .008285820606 × .0034524252525		Interval = .000345244275 Unit = .00069048855 Element .0041429313 × .001726221375	
GROUP +6		GROUP +7	
(1)	64 li. m/m	(1)	128 li. m/m
Interval = .000307578125 Unit = .00061515625 Element .0036909375 × .001537890625		Interval = .0001537890625 Unit = .000307578125 Element .00184546875 × .0007689453125	
(2)	71.84 li. m/m	(2)	143.68 li. m/m
Interval = .0002740116925 Unit = .000548023385 Element .00328814031 × .0013700584625		Interval = .0001370058463 Unit = .0002740116926 Element .0016440701556 × .0006850292315	
(3)	81.2736 li. m/m	(3)	162.5472 li. m/m
Interval = .000242206571 Unit = .000484413142 Element .002906478852 × .001211032855		Interval = .0001211032856 Unit = .0002422065713 Element .0014532394278 × .00060551642825	
(4)	91.1808 li. m/m	(4)	182.3616 li. m/m
Interval = .0002158897485 Unit = .000431779497 Element .002590676982 × .0010794487425		Interval = .0001079448743 Unit = .0002158897487 Element .0012953384922 × .00053972437175	
(5)	102.2464 li. m/m	(5)	204.4928 li. m/m
Interval = .0001925251157 Unit = .0003850502315 Element .002310301389 × .00096262557875		Interval = .0000962625578 Unit = .0001925251157 Element .0011551506942 × .00048131278	
(6)	114.0382 li. m/m	(6)	228.0704 li. m/m
Interval = .0001726221377 Unit = .0003452442754 Element .002071465624 × .0008631106885		Interval = .0000863110688 Unit = .0001726221377 Element .0010357328262 × .00043155534425	
300 li./m m		Interval = .000065616666 Unit = .00013123333 .00078739998 × .000328083325 .0157479996 × .0065616666	
(20)			

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Figure 3 (3 of 3)

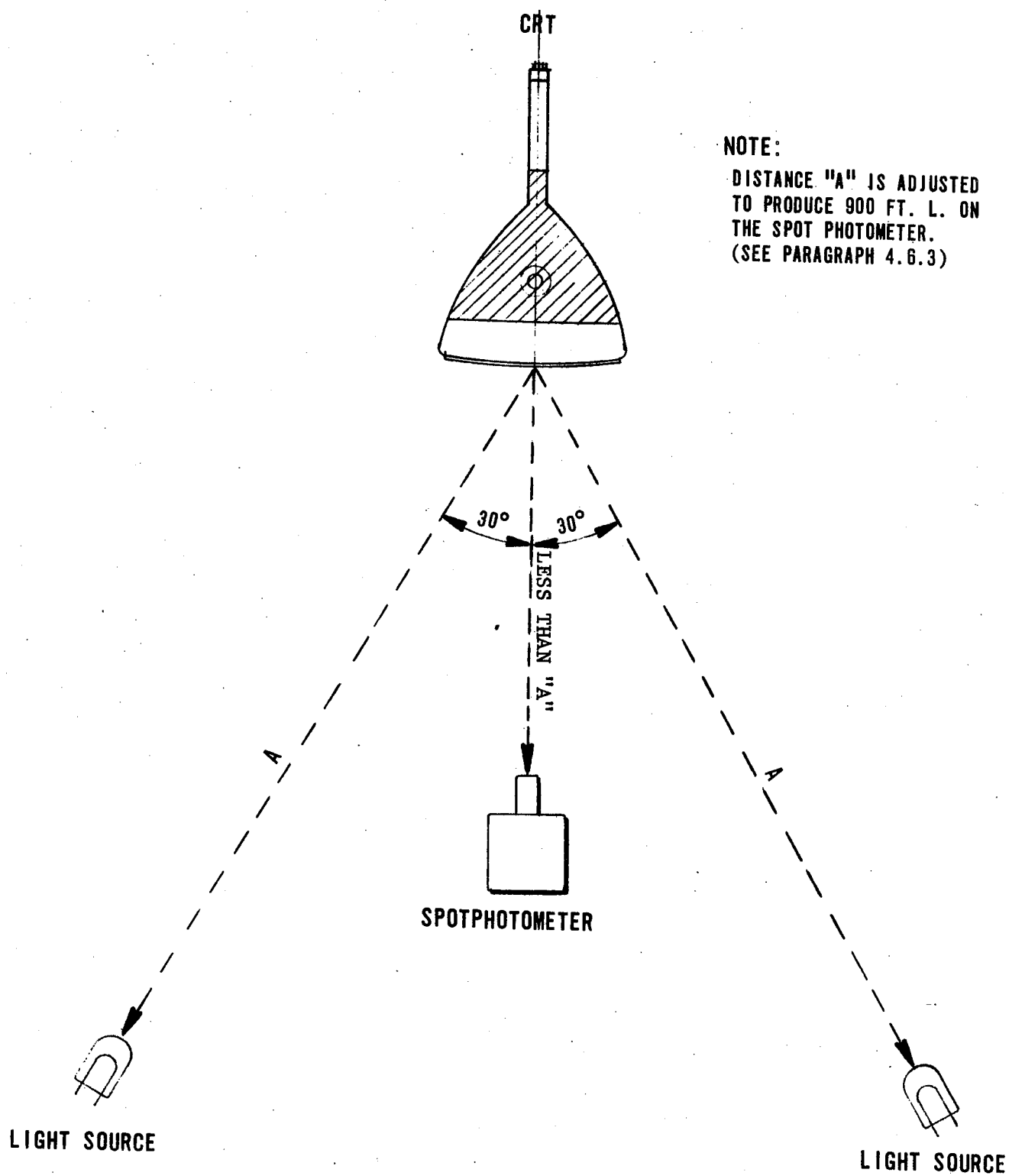


Figure 4. Contrast Ratio Measurement

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